

REMARKS

Claims 1-5 and 6-15 are pending. Claims 6 and 16-27 have been withdrawn from consideration. By the above amendment, claims 1-5 and 13 have been amended and new claims 28-30 have been added. No new matter has been introduced by the above claim amendments and additions.

Claims 1-5 and 7-15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Teong (US Pat. 5,693,563) in view of Hegde et al. (US Pat. 6,136,682).

To establish a *prima facie* case of obviousness, various criteria must be met. For instance, the prior art references must teach or suggest all the claim limitations. Further, there must be some suggestion or motivation in the references or in the knowledge generally available to one skilled in the art to combine the reference teachings. The teaching or suggestion to make the claimed combination must both be found in the prior art and not based impermissible hindsight in view of applicant's disclosure (see, e.g., MPEP 2141, 2143, 2143.03).

Here, at the very least, the combination of Teong and Hedge is legally deficient to establish a *prima facie* case of obviousness against claims 1 and 28 because such combination does not disclose or suggest a *damascene structure comprising a conductor having a random grain orientation, wherein a liner imparts a random grain orientation in the conductive material of the conductor to improve electromigration lifetime of the conductor*, as essentially claimed in claims 1 and 28.

Examiner acknowledges on page 3 of the Final Office Action that Teong does not disclose a liner layer of an amorphous character that would impart a random grain orientation to the conductive material to improve electromigration lifetime of the conductor. Examiner relies

on Hedge as disclosing a composite TaN/TiN film barrier having an amorphous layer of TiN. In the Advisory Action of February 26 2003, in support of Examiner's basis of obviousness and impetus for combining Teong and Hedge, the Examiner states argues "that it is an inherent characteristic of the [TaN/TiN] barrier [of Hedge], as it is formed from amorphous titanium nitride, that it would impart a random grain orientation to the conductive material thus inherently improving the electromigration lifetime of the conductor." It is respectfully submitted that Examiner's basis for obviousness is erroneous for various reasons.


First, both Teong and Hedge are both expressly directed to methods for forming barrier layers to prevent out diffusion of copper atoms from copper conductors into insulating layers. For example, the solution presented by Hedge is to prevent copper from readily diffusing through silicon layers and effecting dielectric constants of insulating material and impairing electrical operation of transistors, (see Col. 1, lines 18-23). There is nothing in either Teong or Hedge that would even remotely suggest to one of ordinary skill in the art a *damascene structure comprising a conductor having a random grain orientation, wherein a liner imparts a random grain orientation in the conductive material of the conductor to improve electromigration lifetime of the conductor*, as essentially claimed in claims 1 and 28. In fact, neither Teong nor Hedge disclose that the conductive material is amorphous (indeed, this is in contrast to conventional wisdom that uniform grain orientation improves the reliability of the conductor). Without more, to base the legal sufficiency of combining Teong and Hedge on the mere disclosure in Hedge of an amorphous barrier layer is nothing more than impermissible hindsight based on Applicants' disclosure.

Furthermore, it is respectfully submitted that Examiner's claim of "inherency" is

conclusory, simplistic and technically unsupported, in that Examiner's fails to explain how one of ordinary skill in the art would recognize such inherent features. Indeed, Examiner ignores the fact that electromigration reliability lifetime can depend on the liner/metal stack and the metallization process used. That strong consideration to the type of materials and processes used in semiconductor fabrication is underscored by Hedge which discloses that the combination of TaN and TiN for forming a barrier layer having a thickness of 400 angstroms provides "unexpected results" over either a single layer of TaN or TiN having the same thickness (see Col. 3. line 18-24). Thus, unless Examiner is willing to submit an affidavit explaining how one of ordinary skill in the art would recognize that the combination of Hedge and Teong inherently discloses the claimed inventions, Applicants respectfully request that Examiner withdraw the claim rejections.

For at least the above reasons, claims 1 and 28 are believed to be patentable and non-obvious over the combination of Teong and Hedge. Claims 2-5 and 7-15 depend from claim 1, and claims 29-30 depend from claim 28. Therefore, the dependent claims are allowable for at least the same reasons given for the independent claims.

Respectfully submitted,

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